Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

IX.

CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

XXXII. — RESEARCHES ON MICROPHONE CURRENTS.

By Charles R. Cross and Annie W. Sabine.

Presented November 14, 1888.

In continuation of studies described in former papers from the Rogers Laboratory, the authors have observed the variations in the secondary current which occur under different circumstances as to mass and normal pressure when the material of the electrodes of a microphone is varied. The methods and apparatus employed were identical with those described in the immediately preceding paper in these Proceedings (page 89).

In the first series of experiments both electrodes were made of the same material, the hammer electrode being a very small button, and the anvil electrode a large one, as in the Blake transmitter. As the mass and pressure upon the anvil electrode were varied, the currents in the secondary at first increased up to a maximum, and afterwards diminished, as shown in the article just referred to, as well as in the curves given with the present paper. Tables I. to XVI. give the numerical results obtained, and Figures 1 to 14 are curves showing the relations between the variables, the loads being abscissas, and the corresponding currents in milliampères the ordinates. The unit of weight adopted was $\frac{8}{10}$ of a gram. The remarks in the third column of the tables indicate the nature of the sound heard in a receiving telephone placed in the secondary circuit. The current was in all cases zero when the load was zero.

TABLE I.

Electrodes. — *Iron, Iron.*

Load.	Current.	Remarks.
1	.19	Sound rough and unsteady.
2	.24	Shrill, clear, metallic, unsteady.
3	.16	" " " "

TABLE II.

Electrodes. — *Platinum, Platinum.*

Load.	Current.	Remarks.
1	.43	
2	.62	Quality good; fluttering.
3	.73	“ “ metallic.
4	.23	“ “ “
5	.10	“ “ fluttering.

TABLE III.

Electrodes. — *Carbon, Carbon.*

Load.	Current.	Remarks.
1	.44	Harsh; loud.
2	.63	“ “
3	.71	Quality good; fluttering.
4	.67	“ “ slight fluttering.
5	.27	“ “ faint fluttering.
6	.18	“ “ “ “
7	.12	“ “ “ “

TABLE IV.

Electrodes. — *Platinum, Carbon.*

Load.	Current.	Remarks.
1	.43	Harsh and loud.
2	.59	“ “
3	.67	Quality good and clear, some fluttering.
4	.59	“ “ “ “ “
5	.12	Faint, fluttering.
6	.09	“ “

TABLE V.

Electrodes. — *Carbon, Platinum.*

Load.	Current.	Remarks.
1	.445	Harsh and loud.
2	.61	Clear; good quality.
3	.66	Clear; some fluttering.
4	.63	Faint; good quality; some fluttering.
5	.29	“ “ “ “ “
6	.20	“ “ “ “ “

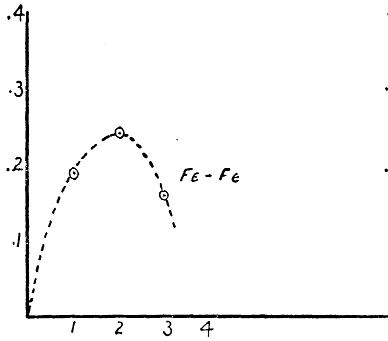

FIG. 1.

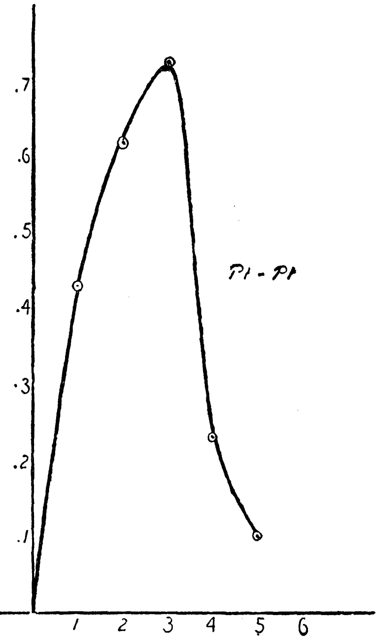

FIG. 2.

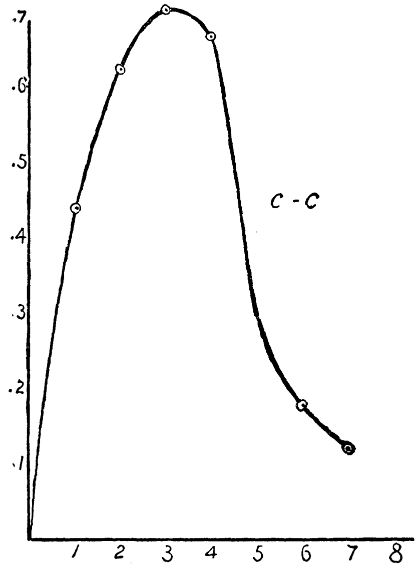

FIG. 3.

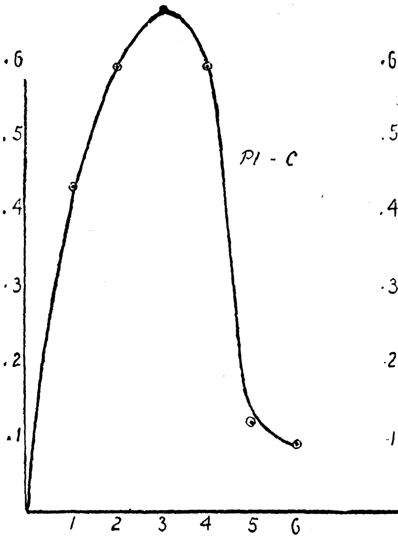

Fig. 4.

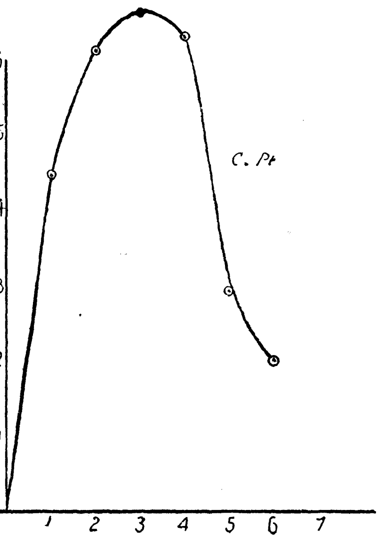

Fig. 5.

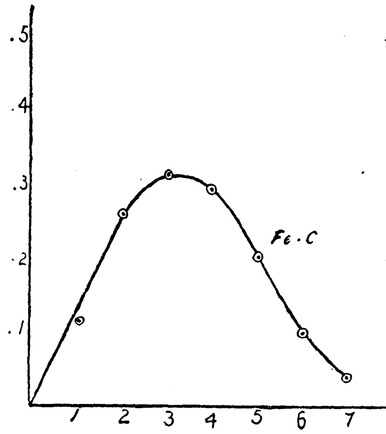

Fig. 6.

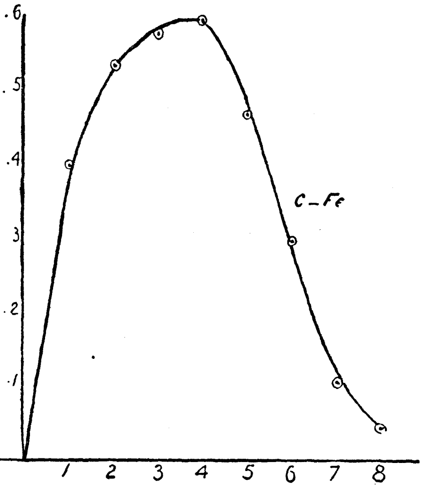

Fig. 7.

TABLE VI.

ELECTRODES. — *Iron, Carbon.*

Load.	Current.	Remarks.
1	.115	Harsh, irregular noise.
2	.260	" " "
3	.310	" " "
4	.290	Clear, good quality ; faint.
5	.200	Faint ; slight fluttering.
6	.095	Faint.
7	.040	"

TABLE VII.

ELECTRODES. — *Carbon, Iron.*

Load.	Current.	Remarks.
1	.395	Harsh and loud.
2	.530	Clear, shrill, good quality.
3	.570	Clear ; fluttering.
4	.590	Quality good ; slightly harsh.
5	.460	" " " "
6	.290	" " " "
7	.100	Very faint.
8	.040	"

TABLE VIII.

ELECTRODES. — *Platinum, Platinum.*

Load.	Current.	Remarks.
1	.450	Harsh and loud.
2	.560	" "
3	.670	Uncertain ; sometimes good quality.
4	.230	Harsh ; fluttering.

TABLE IX.

ELECTRODES. — *Carbon, Carbon.*

Load.	Current.	Remarks.
1	.360	Harsh and loud.
2	.560	Somewhat shrill ; good quality.
3	.620	Good quality, somewhat rough.
4	.545	" " fluttering.
4.5	.225	Faint and rough.
5	.140	Faint.
5.5	.050	"

TABLE X.

Electrodes. — *Iron, Iron.*

Load.	Current.	Remarks.
1	.140	
2	.310	Quality good.
3	.270	
4	.180	

TABLE XI.

Electrodes. — *Platinum, Carbon.*

Load.	Current.	Remarks.
1	.210	Rough.
2	.420	“
3	.540	Quality good ; loud.
4	.630	“ “ slight fluttering.
5	.120	“ “ faint fluttering.
6	.070	“ “ “ “

TABLE XII.

Electrodes. — *Carbon, Platinum.*

Load.	Current.	Remarks.
1	.260	
2	.440	Shrill and loud.
3	.530	Clear, loud, good quality.
4	.620	“ “ “ “
5	.555	Fainter and rougher.

TABLE XIII.

Electrodes. — *Iron, Carbon.*

Load.	Current.	Remarks.
1	.240	Sound uncertain.
2	.300	
3	.310	Clear ; good quality.
4	.290	“ “ “
5	.180	“ “ “ faint.
6	.099	“ “ “ “

TABLE XIV.

Electrodes. — *Carbon, Iron.*

Load.	Current.	Remarks.
1	.345	Rough, steady.
2	.515	
3	.615	Good quality.
4	.560	“ “
5	.235	Faint, rough.
6	.140	Faint ; clear.

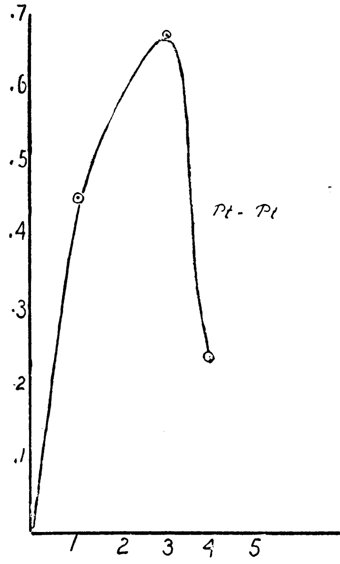

FIG. 8.

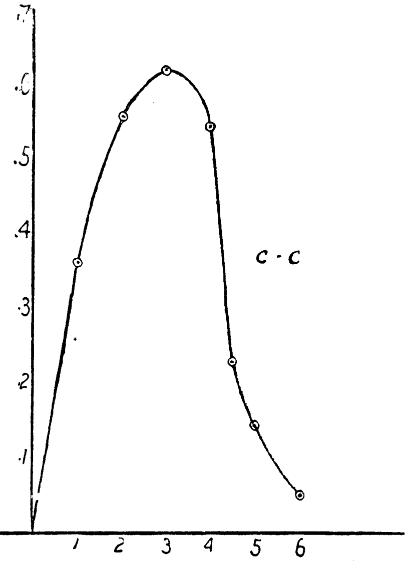

FIG. 9.

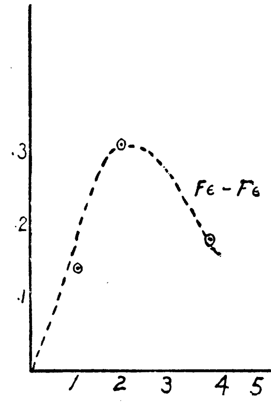

FIG. 10.

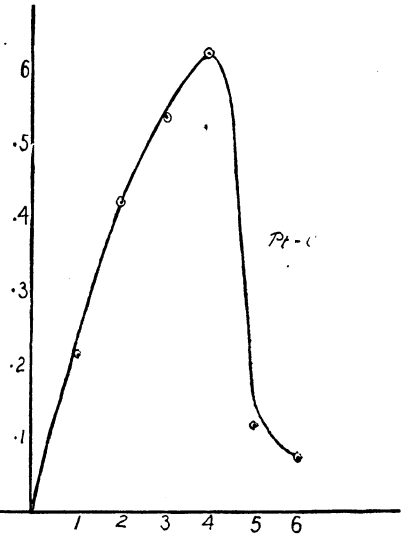

FIG. 11.

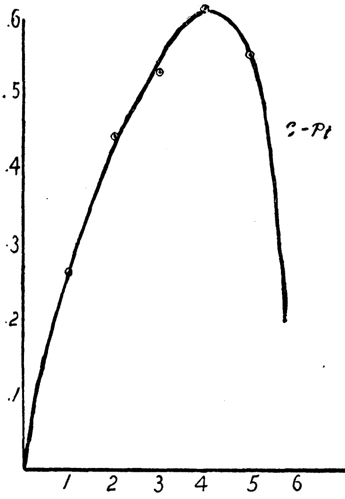

Fig. 12.

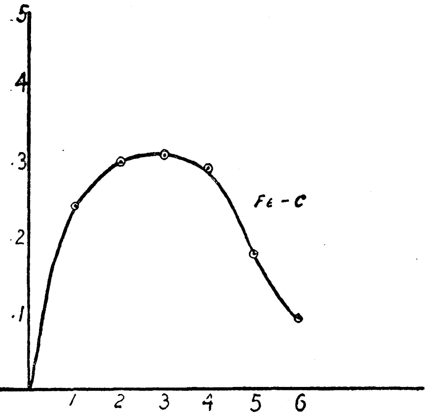

Fig. 13.

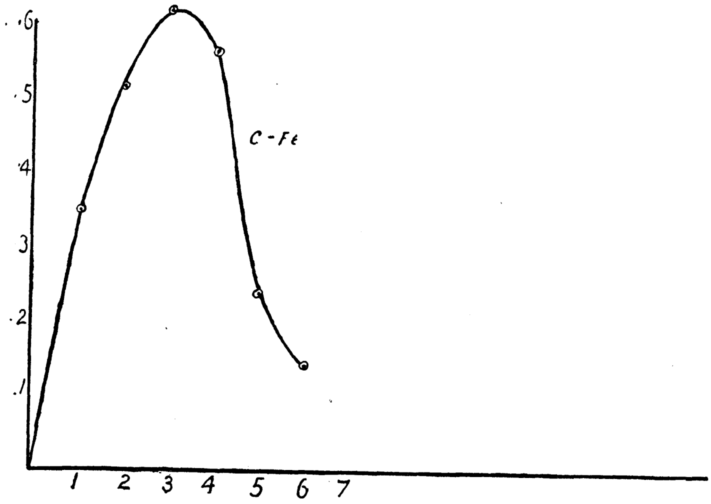

Fig. 14.

TABLE XV.

ELECTRODES. — *Copper, Carbon.*

Load.	Current.	Remarks.
1	.390	Rough and loud.
1.5	.490	" "
2	.590	" "
2 5	.550	" "
3	.250	" "
3.5	.130	" "

TABLE XVI.

ELECTRODES. — *Carbon, Copper.*

Load.	Current.	Remarks.
1	.240	Good quality ; fluttering.
2	.520	" " "
3	.600	" " "
4	.660	" " "
5	.240	" " "
6	.090	" " "

Figures 1 to 3 show very well the characteristics of the substances iron, platinum, carbon. Comparing the curves for carbon and platinum (Figs. 2, 3), it will be seen that the maximum current obtained under the conditions of the experiment was about the same in both cases. But the current falls off far more rapidly with platinum as the pressure is further increased, thus giving to carbon a greater working range of pressure-variation within which it can be practically used in a microphone transmitter, a fact long since recognized in practice. Iron (Fig. 1) has a considerable range, but the current produced is not great.

Tables IV. to VIII., and Figures 4 to 8, illustrate the results obtained when the electrodes were of different materials, the substance of which the anvil electrode is made being the first mentioned. In the experiments now particularly referred to, the two electrodes were made of the customary size, the hammer small and the anvil large.

An inspection of the curves shows that the character of the result obtained under these circumstances was determined chiefly by the material of the anvil rather than of the hammer electrode. This is particularly well illustrated in the case of iron and carbon, as shown in Figures 6 and 7.

This difference persisted even when the hammer and anvil electrodes were made of the same size and shape, as will be seen by an inspection of Tables IX. to XVI. and Figures 9 to 14. We have still to determine whether the same peculiarity would be observed with other modes of mounting the electrodes.

Besides the foregoing results, we have made a determination of the actual strength of the working currents employed on telephone lines. The values previously obtained in the Laboratory had been ascertained from experiments on very short experimental circuits. But through the courtesy of the Long Distance Telephone Company, we were able to put our measuring apparatus in circuit both with the city telephone lines and with one of the long lines to New York.

Several interesting results were thus reached, as shown in Table XVII. The first column gives the name of the transmitter employed, the second the nature of the sound transmitted, the third the location of the transmitter, the fourth the strength of the telephone current in milliampères. The length of the line from 95 Milk Street to the Institute was about two miles; that of the line to New York was two hundred and sixty miles.

TABLE XVII.

Transmitter.	Sound.	Locality of Transmitter.	Current.
Blake	Talking	95 Milk Street	.185
"	Singing	"	.52
Hunnings	Talking	"	.28
"	Singing	"	.78
"	Talking	New York	.02
"	Counting	"	.02−
"	Organ Pipe	"	.01+
"	Counting	Rogers Laboratory	2.05
"	Talking	"	2.20
"	Organ Pipe	"	1.24

The speakers were Dr. W. W. Jacques of Boston and Mr. F. A. Pickernell of New York, who kindly aided us in our work. They are both experts in the use of the telephone, and accustomed to work with each other. The pitch, as well as the loudness of the sounds used, was kept as nearly as possible the same. The vocal sounds transmitted were spoken in a very loud tone, and close to the transmitter.

The figures obtained with the long line to New York are very instructive, as they give some knowledge of the loss of current which is sustained in long distance telephony. When the transmitter was at the Institute, near to the dynamometer, the full current produced by the former passed through the latter instrument, while, when the transmitter in New York was the one used, it is clear that only what was left after all leakage, etc. passed through the measuring instrument. Assuming the sounds as produced at the two stations to be of approximately the same pitch and loudness, it appears that only about one one-hundredth of the original current produced at the transmitting station is finally utilized at the receiving station. It further appears from these figures that about 13 per cent of the current produced at the transmitting station was utilized in ordinary telephonic transmission over the local lines from 95 Milk Street to the Laboratory.

ROGERS LABORATORY OF PHYSICS,
June, 1888.